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## ABSTRACT

This newsletter focuses primarily on the educational facility building systems of Boston and Detroit, and incorporates a brief progress report on the Montreal building project. In addition, the results of ten years of involvement by Educational Facilities Laboratories in exploring the feasibility of developing and applying building systems for schools are illustrated. A chart addresses itself to this task by showing the significant data concerning eight of the building systems programs that were given financial assistance by EFL. (Author/MLF)

# BSIC/EFL NEWSLETTER

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## BUILDING SYSTEMS IN THE CITY

In December 1961, Educational Facilities Laboratories made a grant to Stanford University for the purpose of exploring the feasibility of developing building systems for schools. This marked the beginning of SCSD, a project that was to provide the model for systems development in North America. In the intervening ten years, EFL has continued its interest in systems development through its participation in development projects in Toronto, Montreal and the University of California. In addition, four application projects, which made use of the procedures and products developed in the earlier projects have received EFL assistance.

In the ten year period 1961-1971, these eight projects accounted for 8,748,800 square feet of construction in 117 schools with a total construction cost in today's market of over \$209.6 million.

In order to recap in capsule form EFL's ten year participation in systems, BSIC has prepared a chart showing the significant data on each of the eight projects. (See pages 12-13)

Although these projects have played an important and vital role in the advancement of the systems, they represent only a small portion of the total number of schools designed in this ten year period which have made use of the procedures and hardware developed in the eight projects.

While the first decade has been characterized as one of extensive development of building systems, we have now passed on to the refinement and application stage. This is best illustrated by the Boston and Detroit projects which are the major focuses of this newsletter. Both

projects have made extensive use of the expertise and products developed in Toronto's SEF program.

The educational facility problems of these two major American cities are in many ways similar to those of most American cities. Their school buildings are old. In Boston, for example, one half of the schools are 100 years old or older. The processes through which schools are designed and constructed have become more and more complex with the result that the time required to design and build a school in a major American city has doubled in some cases in the past ten years.

Boston and Detroit present interesting contrasts in their approaches to the solution of their facility problems through the use of building systems and systems procedures. While both projects are still in the process of evolutionary development, they have much to offer that would be of benefit to other large cities.

Rounding out this issue on Systems Building in the City is a brief progress report on the Montreal RAS project. The persistence and dedication of the project leaders has at last borne fruit. The first of the thirteen schools to be constructed in the project is now under construction and letters of intent covering the remaining twelve schools have been issued by the Montreal Catholic School Commission.

The first ten years of systems development have seen the concept grow from a "wild idea" which was given little chance of success to a dynamic process whose potential has just begun to be fulfilled. As we approach the start of a new year we look forward to even greater progress in the decade ahead.

# BOSTCO

## BOSTON STANDARD COMPONENT SYSTEM

Since 1969, the City of Boston Public Facilities Department, the city's construction agency, has been involved in the development of the Boston Standard Component System. This program known as BOSTCO is an effort to apply systems building techniques and procedures, including the use of component building systems, to construction of schools and other public facilities.

The two schools in BOSTCO Track I, a demonstration project intended to show the feasibility and advantages of building systems use, are currently nearing completion. These schools have proven more economical in construction cost and time than schools built conventionally in Boston. As a result of these initial successes, methodology and procedures for further application of systems building are being developed in BOSTCO's Tracks II and III, which will include the construction of six additional schools.

### *The Public Facilities Department*

In 1966, the success of the Boston Redevelopment Authority (BRA) in stimulating renewal by the private construction sector led then-Mayor John Collins and BRA Director Ed Logue to establish the Public Facilities Department (PFD) to serve a similar role in public construction.

In the five years since its establishment, PFD has awarded contracts for 32 new construction projects and for 37 renovation and addition projects totaling \$224.1 million. Of this total, \$148.8 million has been spent on the construction of school facilities (1).

*PFD Activities.* The department was established to act as the building agency of the city and, as such, handles all administrative aspects of the construction process for all city departments. PFD's services include site selection and acquisition, assistance in programming, obtaining funding, and coordination of design and construction.

Project funding is obtained by the department through the City Council on an annual program basis. PFD prepares and submits to the council a loan order to cover the projected contractual obligations for the coming year. If the council approves the order, bonds are sold to maintain the cash flow required for approved projects.

*Department Structure.* PFD is responsible to the Public Facilities Commission, a board of three members appointed by the mayor. This commission appoints the PFD Director, and reviews projects, contracts, and appointments.

Operationally, the department is divided into five sections each of which assumes responsibility for a phase of each construction project. For example, the design section coordinates the project from beginning of preliminary design to completion of design development. Although some small remodeling projects are handled by PFD staff, outside professionals are retained for all major architectural and engineering projects.

*PFD's View of its Role.* In discussions with BSIC, PFD staff members indicated a feeling that the size of their programs and the support services which their professional staff can provide on projects makes them a uniquely "strong client." As a result of this strength, they feel that they can influence the development of new procedures

and processes in the building industry. In order to implement this creative role, they are attempting to improve in-house expertise so that a better balance is achieved between outside professionals, hired consultant services, and staff capabilities.

#### *The Boston Standard Component System Program*

One of the first tasks facing the newly-formed Public Facilities Department was reduction of the backlog in school construction. A report prepared in 1962 indicated a need to construct 35,000 pupil places in new and replacement facilities by 1972—half of Boston's schools are 100 years old or older. By 1969, only 7,000 new places had been provided (2).

The department began its study of building systems in 1967 when it commissioned Earl R. Flansburgh, a Cambridge, Mass., architect, to prepare a report on the SCSD projects. After studying this report, the department rejected the use of the SCSD building system because of the difficulty of adapting what was essentially a suburban solution to an urban situation.

By 1969, however, the Toronto SEF program had successfully developed and applied its First SEF Building System to urban schools. At this time, interest in a building systems approach was renewed in the department under the leadership of Director Robert Kenney, who had been appointed to the PFD directorship by Mayor Kevin White.

Accordingly, a program to apply a building systems approach, based on procedures and products developed on earlier projects and drawing heavily on the SEF experience, to the construction of Boston schools was undertaken. The department staff felt that such a program could be the first step in developing a systems methodology for application to other PFD projects.

**BOSTCO Methodology.** The methodology adopted by PFD calls for the adaptation of systems building methods, including the use of building systems, grouping of projects for economic and management benefits, and systematic project procedures to meet Boston conditions and needs.

Within PFD, a systems team answerable to the PFD director was established, consisting of the Chief Architect, Richard Joslin; Chief Engineer, Victor Hagar, and a systems program director as equal participants. Mr. Nicholas Kuhn served as systems director for BOSTCO Track I and Mr. Ralph Clampitt for Tracks II and III. Mr. Robert J. Vey succeeded Mr. Kenney as PFD director early in 1971.

A proposal by Mr. Flansburgh calling for phasing the BOSTCO program into numerous "Tracks" was ac-

cepted as the basis for program structuring. This proposal called for a demonstration project of two schools in Track I, followed by the undertaking of the development of methodology and technique in Tracks II and III.

In Track I, the user requirements developed in Toronto and the building system developed in response to them would be applied directly. In Track II, similar user requirements would be used but components of the building system would be selected by competitive bidding. In Track III, a fully developed set of local user requirements and related specifications would be used to select components by competitive bidding.

#### **BOSTCO Track I**

In the fall of 1969, EFL granted the City of Boston \$50,000 of the \$150,000 required to undertake the demonstration project. The stated objectives of Track I were to demonstrate the notion of systems building by achieving cost and time savings, thereby establishing a foundation for succeeding stages of the program.

Two school construction projects totaling approximately 200,000 square feet of new construction were assigned to Track I. These were:

- AGASSIZ ELEMENTARY SCHOOL
- GROVER CLEVELAND MIDDLE SCHOOL  
ADDITION

Environment Systems International, a joint venture of Mr. Flansburgh's firm and Robbie Vaughan Williams Jacques Systems of Toronto and Albany, New York, was placed under contract for architectural services and as systems consultants. One of the principals of the latter firm, Mr. Roderick Robbie, had been SEF Technical Director.

**Track I Methodology.** In Track I, the procedure was to bring the SEF building system to Boston, modify it where necessary to meet local conditions and codes, and use it to construct the two schools. A direct application of SEF hardware was selected because SEF had resolved most of the interface and coordination problems of their system and the climate and building configuration requirements of Boston and Toronto were similar.

Because Track I was a demonstration project any problems and opposition encountered could be dealt with on an ad hoc basis. Identification of these problems would assist in development of long term procedures in Tracks II and III.

The SEF Building System used by BOSTCO in this track consisted of five of Toronto's ten subsystems. Included were: Structure, Atmosphere (HVC), Lighting/

ceiling, Interior space division (partitions), and Electric/electronic distribution. A modified SEF exterior skin subsystem was used on one of the two schools.

**Bidding Problems.** Bidding procedures for public works in Massachusetts are defined in Chapter 149 of the General Laws. In this Chapter, a procedure known as "filed sub-bids" is required. In this procedure, sub-contractors in seventeen required categories must file their bids one week before the taking of general contract bids. General contract bidders may list any of these filed subs on their bid, but they must choose their subs from among those listed.

In most systems projects, bidding for installed subsystem components is based upon the treatment of the manufacture and installation of the subsystem as a single contract. The categories for filed sub-bids treat subcontracts on a trade basis, somewhat similar to the manner in which the CSI Standard Format treats them. Under Chapter 149, it was not possible, therefore, to take subsystem based bids.

In order to bid on a subsystem basis in Track I, relief from Chapter 149 requirements was obtained by exercising Section 30-39M of the chapter. This section allows an awarding agency to waive provisions of Chapter 149 when it feels to do so is in its best interests. Systems and nonsystems work for both schools were bid at the same time with bidding generals listing the subsystem contractors as subcontractors. The bid documents—working drawings and specifications—were drafted around the SEF subsystems.

**Other Problems.** In spite of some reluctance, the Boston construction industry was generally cooperative in Track I. Much of this can be attributed to two factors: first, Track I was a demonstration project and, second, PFD and the architects worked with the various groups to insure cooperation.

The architects adopted an attitude that if parties potentially opposed to the project were approached in the right way at the right time, they would be more receptive. An example of how this was done occurred when the building trades shop stewards were taken to Toronto and shown how on-site labor was organized on SEF projects. As a result, there have been few jurisdictional disputes to date.

Although it normally meets Boston code requirements, PFD is required to meet only state schoolhouse standards on school construction. By working with the City Department of Public Safety, the team was able to resolve most code difficulties and to identify and make necessary changes in component requirements.

**Results.** The two schools were bid as one package in

early 1970, with contracts awarded in March. Each of the five Toronto subsystem contractors joined with a local installer on the subsystems' bids. The successful general contractor was a joint venture between a SEF contractor and a local general contracting firm.

In terms of its objectives, Track I has apparently succeeded. The cost per square foot of the two Track I schools is about \$38.40, an estimated 11 per cent below the costs of other schools constructed by PFD since 1968. The construction times for the systems schools are twelve and fourteen months, compared with a shortest schedule of nineteen months for the other schools.

### **BOSTCO Track II**

In mid-1970 as Track I was proving to be successful, PFD decided to undertake Track II. A budget proposal of \$180,000 was prepared and EFL again contacted for assistance. In November 1970, EFL granted Boston an additional \$36,000 for Track II, earmarked for development of staff expertise.

Initially three schools were included in Track II. These schools and their architects were:

- BLACKSTONE SQUARE ELEMENTARY SCHOOL, Stull Associates, Architects
- NORCROSS/HOAR ELEMENTARY SCHOOL, Whitney, Atwood, Norcross, Architects
- QUINCY ELEMENTARY SCHOOL, The Architects Collaborative

The Quincy School has since been postponed to a future program, leaving two schools totaling 246,500 square feet in Track II.

**Track II objectives.** In Track II, the development of systems program methodology is to be undertaken, including the development of PFD in-house systems capability. A second objective is to broaden industry participation in BOSTCO by encouraging competitive bidding in all subsystem categories.

**Track II Methodology.** Track II methodology is developing as a set of pragmatic responses to problems, that is, solutions have been developed for problems uncovered in Track I and in further investigation of the Boston construction industry. Stuart Lessor, current PFD Chief Architect, describes the Track II process as an approach to "enlightened traditional construction."

Unlike the Track I schools, each of the Track II schools was assigned to a separate firm for architectural services. Each of these firms contracted for the consulting services necessary on its project. In addition, the department organized its own team of consultants.

In the areas of bidding procedures and packaging

of Track II systems and construction contracts, the systems team is attempting to keep its options open as long as possible. The size of contract packages will be determined by the capabilities of potential contractors and manufacturers. For example, the lighting/ceiling subsystem will probably be contracted as one package for both schools.

The size of general contract packages will reflect PFD's views of the capabilities of Boston firms. PFD has found that there are numerous firms capable of undertaking projects in the \$5-\$7 million ranges and another group experienced in projects above \$25 million. It is likely, therefore, that the department will seek two contractors for Track II and possibly one for the larger Track III program.

In developing bidding procedures, the systems team is still investigating the possibility of staged bidding and the implications of such a procedure. Track II bidding documentation will probably be a mixture of performance and descriptive type specifications arising from PFD research into industry characteristics and products.

Other procedures are being worked out with emphasis on some of the administrative elements, including proper control of subsystem installation, the tying of payments to established schedule targets, and maximum feedback of costing information for use in future programs.

**Subsystem Decisions.** Although Track II is in its early stages, some decisions regarding the performance of subsystems to be used have been made. For example, the HVC subsystem will probably use satellite multi-zone air handling units provided with hot and cold water from a central plant and with factory installed controls. Under an agreement reached during the development of Track I, a return air plenum above the ceiling is permitted if temperature rise and smoke detectors controlling the return air fans are located within the plenum.

PFD is interested in increasing its role in project management on BOSTCO schools and is working on procedures and mechanisms for Track II which give the client greater control of the design and construction processes. In so doing, it is seeking to complement not supplant design and construction professionals.

### **BOSTCO Track III**

The structure of Track III gives additional insight into the role which the Public Facilities Department sees itself and systems building playing in public construction in Boston. At the present time, Track III has

been programmed and four construction projects assigned to it.

These four schools total approximately 600,000 square feet of new construction and include an elementary school, a middle school, and two composite use facilities. The schools are:

- BUNKER HILL ELEMENTARY SCHOOL
- BARNES MIDDLE SCHOOL
- CARTER PLAYGROUND, ELEMENTARY AND MIDDLE SCHOOLS
- WASHINGTON-ALLSTON ELEMENTARY SCHOOL/HORACE MANN SPECIAL EDUCATION FACILITY

**Track III Objectives.** In the *Introduction to Track III*, PFD lists seven objectives. This list could serve as a restatement of the general BOSTCO objective after the experience in Tracks I and II. The seven objectives are:

1. Recognize and involve expertise among users, staff, industry and professionals through a restructured approach to the projects.
2. Increase the rate and predictability of school delivery through overall coordination, and choice of components and techniques favoring rapid design and construction.
3. Utilize compatibility and uniformity within and between components to avoid costly waste and to promote interchangeability.
4. Apply cost-benefit analysis to component assemblies before incorporation into the project.
5. Achieve uniform construction processes which are efficient in the use of industrialized or organized handicraft techniques.
6. Enforce the construction-management approach by developing documents requiring administrative and management expertise at both the general contractor and subcontractor levels.
7. Obtain detailed in-place cost data by organizing the project around units of completion (3).

The impact of these objectives will be to restructure traditional means of project delivery into a process in which the client will have increased participation and control.

**Track III Structure.** Although much of Track III's procedures are conjectural at present, the project design structure shows this increased role of PFD as the client. In Track II, each architect formed his own project design team of consultants. This created a situation in which PFD had to deal with a number of consultants whose contractual responsibility was to the architect.

In Track III, the department plans to use a two-stage relationship between consultants, architects, and the client. For the research and development of the building system and project procedures, consultants will be

contracted to the department. For the design of the individual schools, the architects will place these same consultants under contract as project consultants.

### Conclusions

The BOSTCO program shows how the procedures and hardware developed in the large-scale building systems programs such as SEF may be adapted to fit different conditions. In Boston, this adaptation has required major rethinking and restructuring of concepts, procedures, and even hardware.

Also, the Boston program is an example of how a systems program may be integrated into existing governmental structures. The advantage of this type of integration is the continuity and overall control gained. Properly managed, this long term control makes the value of the total systems approach, including feedback from each stage, more realistic.

## BOSTCO TRACK I

School Department, City of Boston  
Boston, Massachusetts

### Administrative agency:

Public Facilities Department, City of Boston

### Design team:

Environment Systems International, architects and systems consultants  
Yolles and LeMessurier, Joint Venture, structural engineers  
Associated Environmental Systems, mechanical/electrical engineers

### Subsystems:

STRUCTURE: Anthes-Canron SEF System  
LIGHTING/CEILING: Canadian Johns-Manville Ltd.  
HVC: Canadian Electric ITT RTMZ  
PARTITIONS: Westeel-Roscoe Ltd.  
ELECTRIC/ELECTRONIC: Electro-Link Systems, Ltd.

**General contractor:** Jackson-Vanbots, Joint Venture

## GROVER CLEVELAND MIDDLE SCHOOL ADDITION

**Building size:** 90,000 square feet to increase school enrollment to 1200 students

### Project costs:

SUBSYSTEMS LISTED: \$1,481,200  
BUILDING COST: \$3,490,150, or \$38.77/sq. ft.  
CONSTRUCTION COST: \$3,615,150

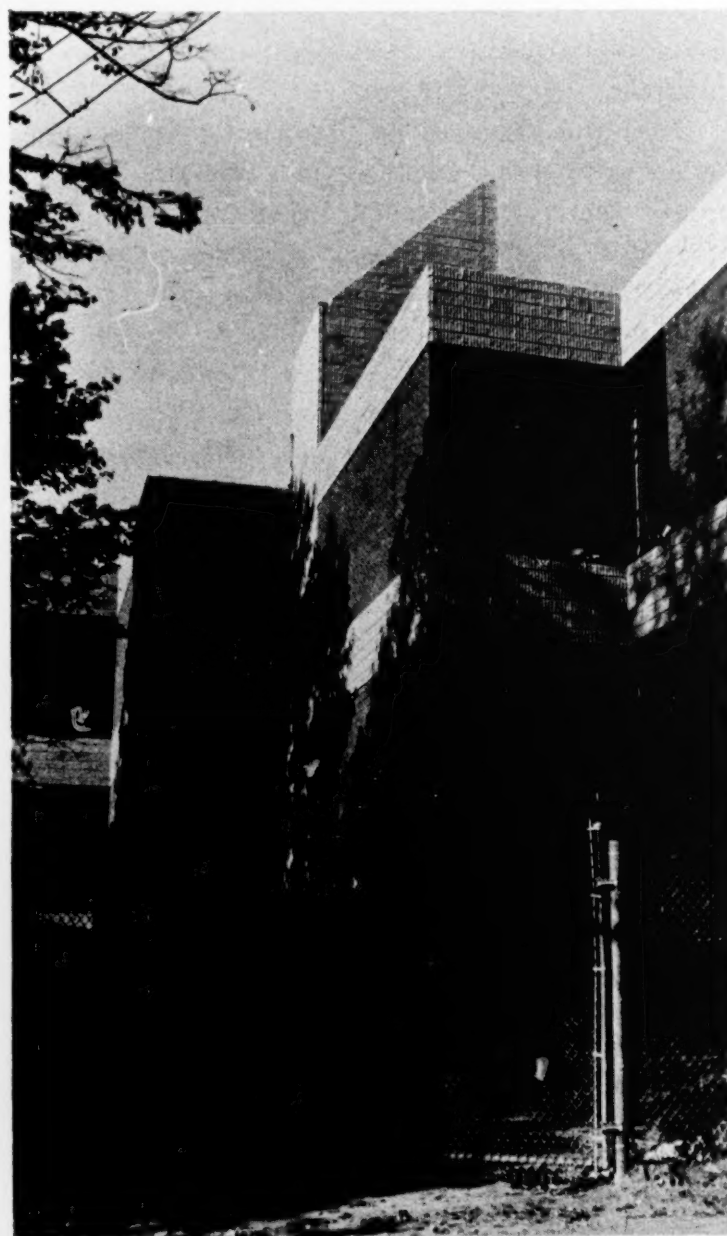
### Project schedule:

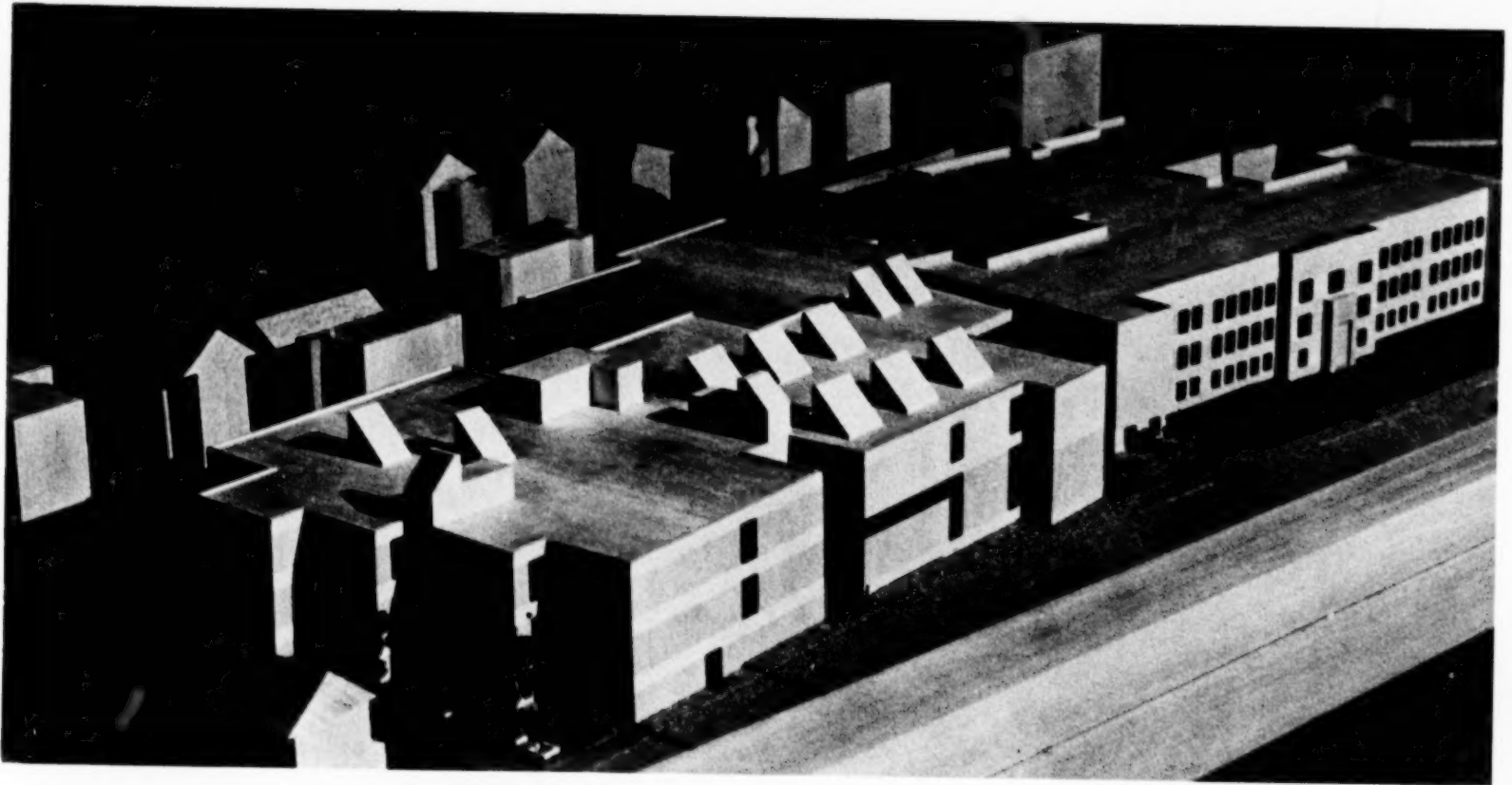
DESIGN BEGUN: March 1970  
CONSTRUCTION BEGUN: March 1971  
CONSTRUCTION COMPLETED: estimate March 1972

On the other hand, such an integration makes its own demands and has its own disadvantages. The danger of control mechanisms developing inertia is always present. The PFD in Boston appears, however, to be aware of these problems and to be a highly creative element, both in the Boston construction picture and as a broader influence.

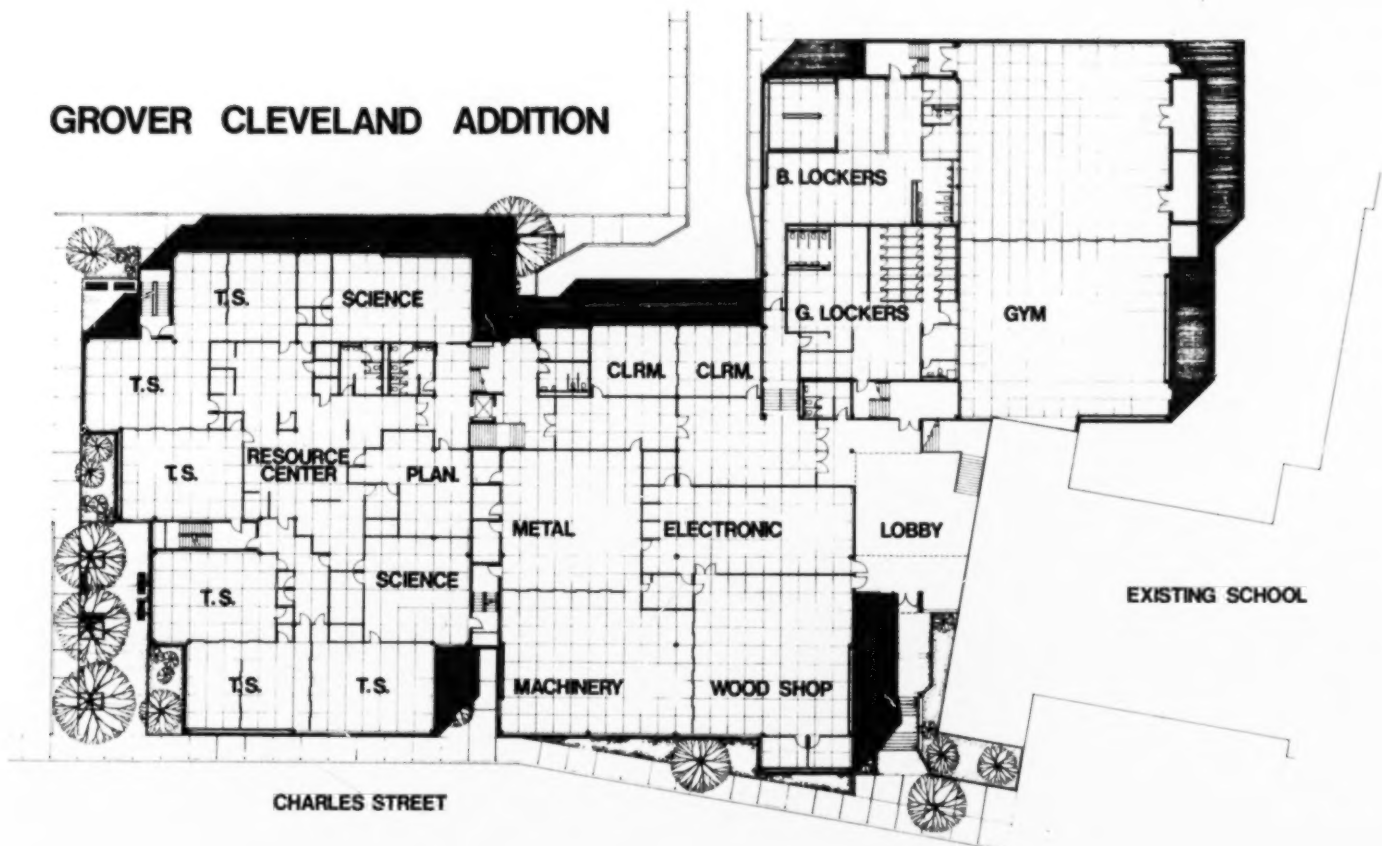
### FOOTNOTES

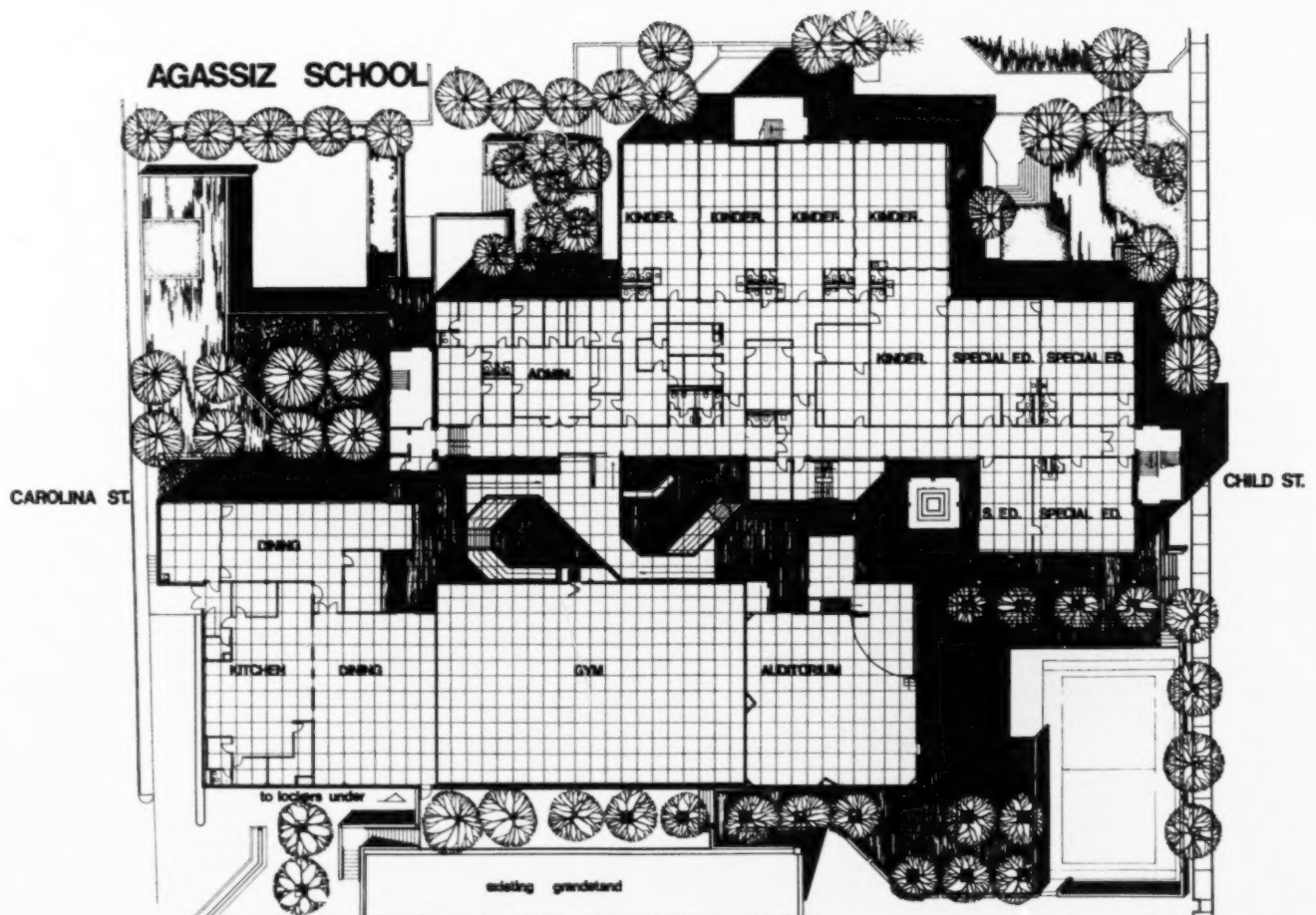
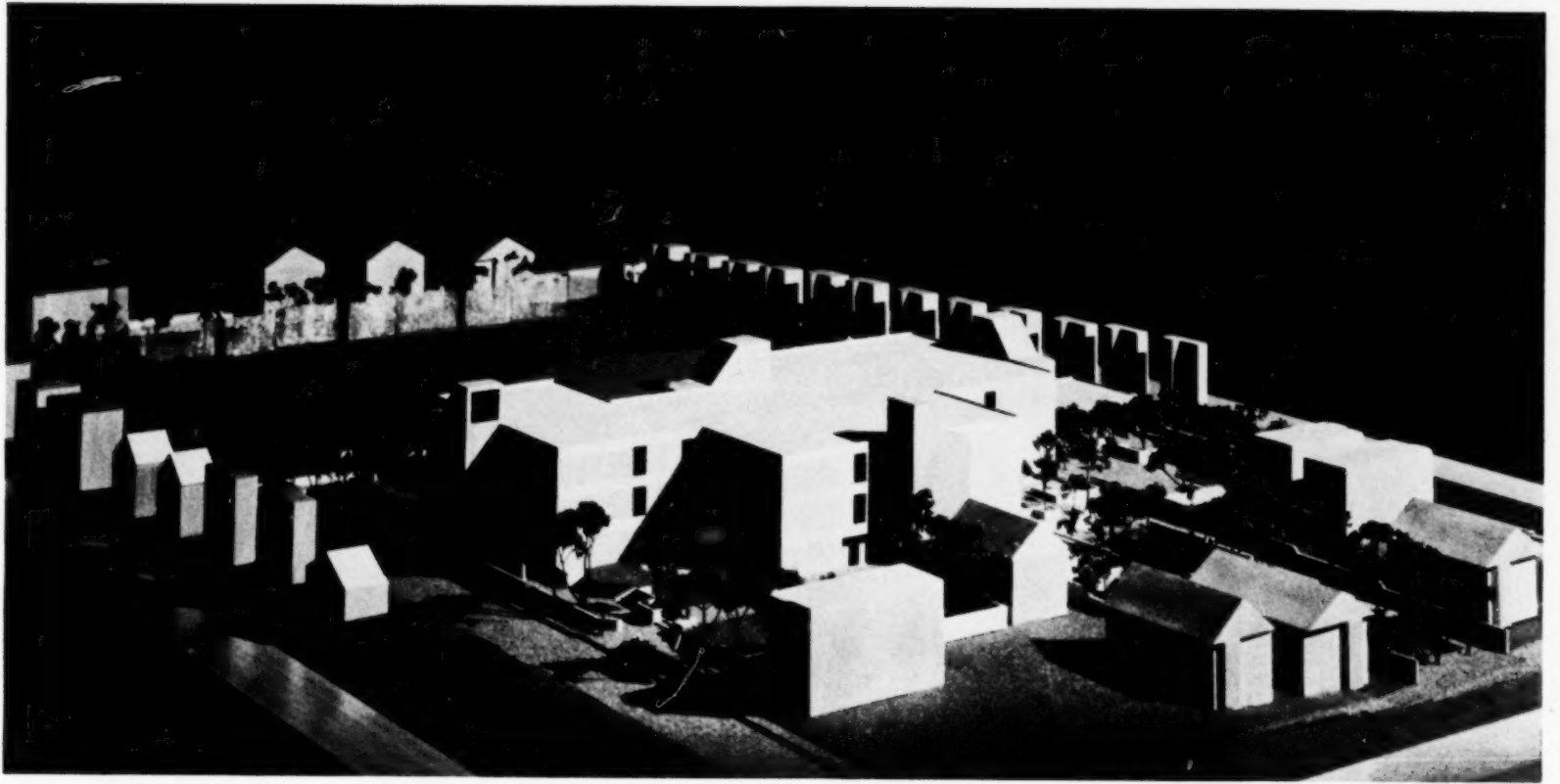
- (1) Public Facilities Department, *Boston Standard Component System (BOSTCO) City of Boston, Introduction to Track III*, October 12, 1971, Page 7.
- (2) Kuhn, Nicholas, "Systems Building for Schools in Boston: The BOSTCO Program," *New England Architect*, October 1970.
- (3) Public Facilities Department, *Boston Standard Component System (BOSTCO) City of Boston, Introduction to Track III*, October 12, 1971, Page 19.





# GROVER CLEVELAND ADDITION







## AGASSIZ ELEMENTARY SCHOOL

**Building size:** 110,000 square feet to accommodate 850 students plus community use facilities

**Project costs:**

SUBSYSTEMS LISTED: \$1,760,200  
 BUILDING COST: \$4,184,400, or \$38.04/sq. ft.  
 CONSTRUCTION COST: \$4,509,400

**Project schedule:**

DESIGN BEGUN: approx. Jan. 1, 1970  
 CONSTRUCTION BEGUN: March 1971  
 CONSTRUCTION COMPLETED: estimate March 1972



# CSP

## DETROIT'S CONSTRUCTION SYSTEMS PROGRAM

In Detroit, Michigan, rising construction costs, lengthening construction times and a need for special use space at the secondary school level have led the Detroit Public Schools to undertake a systems building program known as the Construction Systems Program (CSP). During the summer of 1972, four secondary school additions which total approximately 280,000 square feet of new construction will be put into service in CSP-1, the first stage of the program.

The CSP Program combines various systems building techniques, including the use of building systems, staged bidding, volume purchasing, performance specifications and construction management, in an effort to meet and overcome the problems of providing facilities in an urban school district.

### *The Detroit Public Schools*

The Detroit Public Schools are governed by the Detroit Board of Education, an elective body of thirteen members. The school district operates over 300 schools for a school enrollment of about 295,000 students. In spite of a general decrease in Detroit's population, school enrollment has remained relatively constant over the past two decades, attributable in part to the phasing out of an extensive parochial school system.

For the past several years, the Board of Education has been working towards administrative decentralization and increased community control of schools. As a result of these efforts, the school district is presently divided into eight "regions," each under a regional board of education.

*Building Schools in Detroit.* All aspects of school facilities provision from advanced planning to building maintenance are the responsibility of the district's School Housing Division. The organizational structure of this division is diagrammed in Figure 1. Directors of the division are Dr. Alvin G. Skelly, Deputy Superintendent, and Mr. Bernard L. Coker, Assistant Superintendent.

Although some small jobs are done by the division's professional staff, most architectural work is done by private firms under contract to the Board. One requirement of the architect's contract is that he work with community groups in the planning and design of school facilities.

As in many American school districts, the financing of school construction projects is through the sale of bonds backed by the city's property tax base and approved by the voters at bond issue referendums. The Detroit school district obtained a two per cent increase in bonding capacity from the state legislature in 1971, which will permit annual construction programs of \$40 to \$50 million.

*Detroit's Facility Needs.* Although school population has been stable, the city has a great backlog of facility needs, especially at the secondary school level. Many Detroit high schools average about one-half the area per pupil available in recently built suburban and "out-state" schools. In some cases, this shortage of space—about eighty square feet are available per pupil in the city's older secondary schools—has been relieved by staggered class schedules, a not entirely satisfactory solution.

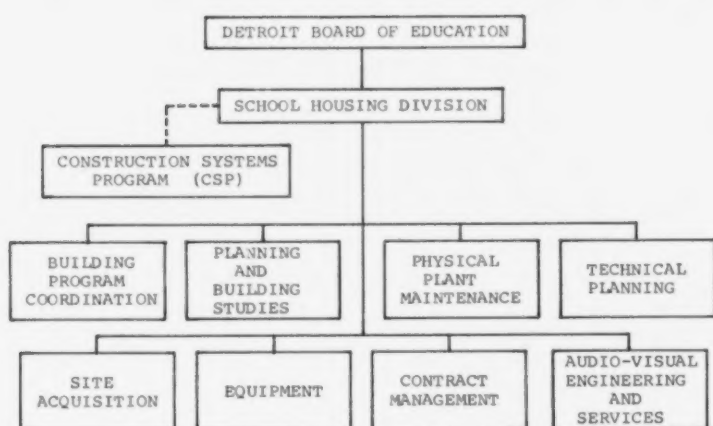


Figure 1

### Major Departments of the School Housing Division Detroit Public Schools

The shortage is particularly acute in specialized use space, that is, space housing programs with high service needs such as vocational-technical programs and the sciences. Although many of Detroit's secondary schools are substantial structures built in the period 1920-1960 and adaptable to general space uses such as classrooms and offices, it is difficult to put programs with sophisticated technology and service requirements into these older buildings.

**Rising Costs and Lengthening Schedules.** In Detroit, as in other urban areas, the costs of construction for schools have been rising and the time required to construct them lengthening. It has been estimated that average construction costs for Detroit schools have risen seventy per cent in the past nine years, while construction time has increased an average of fifty per cent in the same period (1).

Although cost trends are similar throughout the metropolitan Detroit area, construction time increases have been greater in the inner city due to a variety of contractor/labor/regulatory agency problems.

#### The Construction Systems Program

In 1969, the school district began a two year program—the Construction Systems Program (CSP)—to apply building systems as a means of providing supplementary space and of combatting rising costs and lengthening construction schedules. In April 1969, the first of a series of EFL grants totalling \$130,000 was made to Detroit to assist with the funding of CSP.

Mr. Ben Graves of the Great Cities Research Council and Mr. Wallace B. Cleland, AIA, of the School Housing Division staff, working with Dr. Skelly, developed initial project directions and objectives and prepared the EFL grant proposal. Mr. Cleland was appointed technical director for the program.

One of the first CSP activities was the formation of an advisory committee to provide overall guidance for the project. The members of this committee, listed in Table I, have taken an active and useful role in giving direction and assistance to the program.

**CSP Procedures.** From its beginnings, CSP has been viewed as a project to develop and demonstrate new approaches to construction. In a recent letter to BSIC, Mr. Cleland stated:

CSP is not a super independent agency (like the Chicago Public Building Commission), but a temporary developmental/demonstration project. The focus of our recently approved supplemental grant from EFL is incorporating or internalizing what has been learned in CSP-1 (and what will be learned in CSP-2) into the regular ongoing building program practices of the School Housing Division (2).

The original CSP proposal envisioned a large demonstration program of approximately ten 50,000 square foot construction projects over a two-year period. By grouping several projects together in one bidding and construction package, it was felt that the advantages of industrialized construction could be obtained. Such a large package would provide sufficient volume for economic production runs and for a logical sequence of construction activities.

After further study of the problem, the advisory committee, at the suggestion of Dr. Skelly and Mr. John Lansing, Director of Building Program Coordination, recommended a "two-track" effort for CSP. In this two-track structure, the first track, CSP-1, would consist of four addition projects for which funds had already been allocated and architects designated. Knowledge gained in this program would be applied to a subsequent more comprehensive CSP-2 program.

#### CSP-1

The recommendation for a four-addition CSP-1 was accepted in February 1970, and work with the four architectural firms began immediately. In response to advisory committee fears about imposing building systems on architects who had been commissioned to do conventionally-built projects, the architects were asked initially to explore the possible advantages of systematization with CSP. Ultimately, the four firms accepted and used building systems.

In March 1970, the consultant team for CSP-1 was formed. Consultants were chosen in the areas of systems planning, mechanical and electrical engineering, structural engineering and building codes, construction cost and scheduling, and educational planning. With the

*Continued on page 14*

| PROJECT (State, Dates)<br><br>CONSTRUCTION PROGRAMS | DATES     | SCHOOL TYPE |              |           |                  |       | LOCATION |          | PROJECT VOLUME |            |                      |              | BU             |                 |               |                  |            |                   |
|-----------------------------------------------------|-----------|-------------|--------------|-----------|------------------|-------|----------|----------|----------------|------------|----------------------|--------------|----------------|-----------------|---------------|------------------|------------|-------------------|
|                                                     |           | Elementary  | Intermediate | Secondary | Higher education | Other | Urban    | Suburban | Rural          | University | Number of Facilities | AREA         | BUILDING COST  |                 | Structure HVC | Lighting/ceiling | Partitions |                   |
|                                                     |           |             |              |           |                  |       |          |          |                |            |                      |              | AT TIME OF BID |                 |               |                  |            | NOV. 1971 DOLLARS |
|                                                     |           |             |              |           |                  |       |          |          |                |            |                      |              | Total          | Per Square Foot |               |                  |            |                   |
|                                                     |           |             |              |           |                  |       |          |          |                |            |                      |              |                |                 |               |                  |            |                   |
| <u>Development Projects</u>                         |           |             |              |           |                  |       |          |          |                |            |                      |              |                |                 |               |                  |            |                   |
| SCSD (Cal., 1962-1968)                              |           |             |              |           |                  |       |          |          |                |            |                      |              |                |                 |               |                  |            |                   |
|                                                     | 1965-1966 |             |              | •         |                  |       | •        |          |                | 4          | 614,468              | \$10,111,898 | \$18.10        | \$15,724,000    | •             | •                | •          |                   |
|                                                     | 1966-1968 | •           |              | •         |                  |       | •        |          |                | 7          | 805,422              | \$15,429,565 | \$19.16        | \$23,029,109    | •             | •                | •          |                   |
|                                                     | 1967-1968 |             |              | •         |                  |       | •        |          |                | 2          | 165,563              | \$ 2,915,542 | \$17.60        | \$ 4,116,445    | •             | •                | •          |                   |
| SCSD TOTAL                                          |           |             |              |           |                  |       |          |          |                | 13         | 1,585,453            | \$28,458,005 | \$17.95        | \$42,869,854    |               |                  |            |                   |
| <u>SEF (Ont., 1966- )</u>                           |           |             |              |           |                  |       |          |          |                |            |                      |              |                |                 |               |                  |            |                   |
| PROGRAM 1                                           | 1969-1970 | •           | •            |           |                  |       | •        | •        |                | 11         | 671,593              | \$15,125,909 | \$22.52        | \$18,362,285    | •             | •                | •          |                   |
|                                                     | 1970-1971 | •           | •            |           |                  | •     | •        | •        |                | 10         | 584,493              | \$13,735,585 | \$23.50        | \$15,164,085    | •             | •                | •          |                   |
| PROGRAM 1-B                                         | 1971-1972 | •           |              |           |                  | •     | •        | •        |                | 4          | 250,000              | \$ 5,545,000 | \$22.18        | \$ 5,578,270    | •             | •                | •          |                   |
| SEF TOTAL                                           |           |             |              |           |                  |       |          |          |                | 25         | 1,506,086            | \$34,306,494 | \$22.75        | \$39,104,640    |               |                  |            |                   |
| URBS (Cal., 1966- )                                 | 1969-1971 |             |              |           | •                |       |          |          | •              | 1          | 77,400               | \$ 2,253,404 | \$29.16        | \$ 2,771,686    | •             | •                | •          |                   |
| <u>RAS (Que., 1966- )</u>                           |           |             |              |           |                  |       |          |          |                |            |                      |              |                |                 |               |                  |            |                   |
| PILOT SCHOOL                                        | 1971-1972 | •           |              |           |                  |       | •        |          |                | 1          | 58,815               | \$ 1,251,000 | \$21.30        | \$ 1,267,263    | •             | •                | •          |                   |
|                                                     | 1971-1974 | •           |              | •         |                  |       | •        |          |                | 12         | 1,645,385            | \$34,000,000 |                | \$34,000,000    | •             | •                | •          |                   |
| <u>Off-the-Shelf Projects</u>                       |           |             |              |           |                  |       |          |          |                |            |                      |              |                |                 |               |                  |            |                   |
| SSP (Fla., 1967- )                                  |           |             |              |           |                  |       |          |          |                |            |                      |              |                |                 |               |                  |            |                   |
| PROGRAM 1-A                                         | 1967-1968 | •           | •            | •         |                  |       | •        | •        |                | 6          | 257,246              | \$ 3,704,671 | \$14.70        | \$ 5,045,762    | •             | •                | •          |                   |
| LEON                                                | 1967-1968 | •           |              |           |                  |       |          |          | •              | 1          | 64,551               | \$ 946,372   | \$14.66        | \$ 1,288,959    | •             | •                | •          |                   |
| PROGRAM 2                                           | 1968-1969 | •           | •            |           |                  |       | •        | •        |                | 9          | 487,912              | \$ 8,030,631 | \$16.46        | \$ 9,676,910    | •             | •                | •          |                   |
| PROGRAM 3                                           | 1968-1969 | •           | •            |           |                  |       | •        | •        |                | 8          | 463,315              | \$ 6,998,089 | \$15.09        | \$ 8,432,697    | •             | •                | •          |                   |
| OKALOOSA                                            | 1969      | •           |              |           |                  |       |          |          | •              | 1          | 44,450               | \$ 626,568   | \$14.10        | \$ 777,571      | •             | •                | •          |                   |
| CLAY/DUVAL                                          | 1969-1970 |             |              | •         |                  |       | •        | •        |                | 3          | 522,199              | \$ 8,437,038 | \$16.16        | \$10,326,935    | •             | •                | •          |                   |
| MARTIN                                              | 1969-1970 |             |              | •         |                  |       |          |          | •              | 1          | 55,800               | \$ 916,692   | \$16.43        | \$ 1,122,031    | •             | •                | •          |                   |
| ALACHUA/HERNANDO                                    | 1969-1970 | •           | •            |           |                  |       | •        | •        |                | 2          | 67,824               | \$ 1,087,672 | \$16.04        | \$ 1,340,012    | •             | •                | •          |                   |
| BREVARD                                             | 1970      | •           |              |           |                  |       |          |          | •              | 1          | 50,700               | \$ 830,000   | \$16.37        | \$ 995,170      | •             | •                | •          |                   |
| GADSDEN                                             | 1970      | •           |              |           |                  |       |          |          | •              | 2          | 25,216               | \$ 385,232   | \$15.28        | \$ 461,893      | •             | •                | •          |                   |
| CLAY                                                | 1970      |             |              | •         |                  |       | •        |          |                | 1          | 97,907               | \$ 1,349,945 | \$13.79        | \$ 1,618,584    | •             | •                | •          |                   |
| HENDRY                                              | 1970-1971 |             |              | •         |                  |       |          |          | •              | 1          | 68,880               | \$ 1,020,358 | \$14.81        | \$ 1,172,391    | •             | •                | •          |                   |
| LEVY                                                | 1970-1971 | •           |              |           |                  |       |          |          | •              | 1          | 19,610               | \$ 327,900   | \$16.72        | \$ 376,757      | •             | •                | •          |                   |
| BRADFORD                                            | 1970-1971 |             |              | •         |                  |       |          |          | •              | 1          | 14,000               | \$ 213,000   | \$15.21        | \$ 244,737      | •             | •                | •          |                   |
| LEE                                                 | 1970-1971 | •           |              |           |                  |       |          |          | •              | 1          | 89,120               | \$ 1,551,163 | \$17.41        | \$ 1,782,286    | •             | •                | •          |                   |
| BROWARD I                                           | 1970-1971 | •           | •            | •         |                  |       | •        |          |                | 6          | 719,003              | \$17,428,689 | \$24.24        | \$20,025,563    | •             | •                | •          |                   |
| BROWARD II                                          | 1970-1971 | •           | •            |           |                  |       | •        |          |                | 2          | 153,975              | \$ 3,040,515 | \$19.75        | \$ 3,493,552    | •             | •                | •          |                   |
| PROGRAM 4                                           | 1971-1972 | •           | •            | •         |                  |       | •        |          |                | 3          |                      |              |                |                 | •             | •                | •          |                   |
| SSP TOTAL                                           |           |             |              |           |                  |       |          |          |                | 50         | 3,201,708            | \$56,894,535 | \$17.75        | \$68,181,810    |               |                  |            |                   |
| <u>GSSC (Ga., 1969- )</u>                           |           |             |              |           |                  |       |          |          |                |            |                      |              |                |                 |               |                  |            |                   |
| PROGRAM 1                                           | 1969-1970 | •           |              |           |                  |       | •        | •        |                | 8          | 45,528               | \$ 999,800   | \$21.95        | \$ 1,223,755    | •             | •                | •          |                   |
| PROGRAM 2                                           | 1970-1972 |             |              | •         |                  |       | •        |          |                | 1          | 148,460              | \$ 2,708,000 | \$18.24        | \$ 2,708,000    | •             | •                | •          |                   |
| GSSC TOTAL                                          |           |             |              |           |                  |       |          |          |                | 9          | 193,988              | \$ 3,707,800 | \$19.10        | \$ 3,931,755    |               |                  |            |                   |
| <u>CSP (Mich., 1969- )</u>                          |           |             |              |           |                  |       |          |          |                |            |                      |              |                |                 |               |                  |            |                   |
| CSP-1                                               | 1971-1972 |             |              | •         | •                |       | •        |          |                | 4          | 280,000              | \$ 8,850,144 | \$30.84        | \$ 9,390,002    | •             | •                | •          |                   |
| <u>BOSTCO (Mass., 1969- )</u>                       |           |             |              |           |                  |       |          |          |                |            |                      |              |                |                 |               |                  |            |                   |
| TRACK I                                             | 1971-1972 | •           | •            |           |                  |       | •        |          |                | 2          | 200,000              | \$ 7,674,550 | \$38.37        | \$ 8,434,330    | •             | •                | •          |                   |

|                      | BUILDING SYSTEM |     |                  |            |               |          |                     |          |           |         |       | MANAGER                       |                    |                      | NOTES |                       |  |
|----------------------|-----------------|-----|------------------|------------|---------------|----------|---------------------|----------|-----------|---------|-------|-------------------------------|--------------------|----------------------|-------|-----------------------|--|
|                      | Structure       | HVC | Lighting/ceiling | Partitions | Exterior wall | Plumbing | Electric/electronic | Casework | Carpeting | Roofing | Other | Per Cent of Cost<br>in System | General contractor | Construction manager |       | Management contractor |  |
| NOV. 1971<br>DOLLARS |                 |     |                  |            |               |          |                     |          |           |         |       |                               |                    |                      |       |                       |  |
| 15,724,000           | •               | •   | •                | •          |               |          |                     | •        |           |         | •     | 42                            | •                  |                      |       |                       |  |
| 23,029,109           | •               | •   | •                | •          |               |          |                     | •        |           |         | •     |                               | •                  |                      |       |                       |  |
| 4,116,445            | •               | •   | •                | •          |               |          |                     | •        |           |         | •     |                               | •                  |                      |       |                       |  |
| 42,869,854           |                 |     |                  |            |               |          |                     |          |           |         |       |                               |                    |                      |       | 2                     |  |
| 18,362,285           | •               | •   | •                | •          | •             | •        | •                   | •        | •         | •       | •     | 79                            |                    | •                    |       |                       |  |
| 15,164,085           | •               | •   | •                | •          | •             | •        | •                   | •        | •         | •       | •     | 80                            |                    | •                    |       |                       |  |
| 5,578,270            | •               | •   | •                | •          | •             | •        | •                   | •        | •         | •       | •     | 80                            |                    | •                    |       | 1                     |  |
| 39,104,640           |                 |     |                  |            |               |          |                     |          |           |         |       |                               |                    |                      |       | 1,3                   |  |
| 2,771,686            | •               | •   |                  | •          |               |          |                     |          |           |         |       | 51                            |                    |                      | •     |                       |  |
| 1,267,263            | •               | •   | •                | •          |               |          | •                   |          |           |         |       | 35                            | •                  |                      |       | 1                     |  |
| 34,000,000           | •               | •   | •                | •          |               |          | •                   |          |           |         |       | 35                            | •                  |                      |       | 1,4                   |  |
| 5,045,762            | •               | •   | •                |            |               |          |                     |          |           |         |       | 35                            | •                  |                      |       |                       |  |
| 1,288,959            | •               | •   | •                |            |               |          |                     |          |           |         |       | 33                            | •                  |                      |       |                       |  |
| 9,676,910            | •               | •   | •                | •          |               |          |                     | •        | •         |         |       | 32                            | •                  |                      |       |                       |  |
| 8,432,697            | •               | •   | •                | •          |               |          |                     | •        | •         | •       |       | 41                            | •                  |                      |       |                       |  |
| 777,571              | •               | •   | •                |            |               |          |                     |          |           |         |       |                               | •                  |                      |       |                       |  |
| 10,326,935           | •               | •   | •                | •          |               |          |                     |          | •         | •       |       | 41                            | •                  |                      |       |                       |  |
| 1,122,031            | •               | •   | •                | •          |               |          |                     |          |           |         |       | 32                            | •                  |                      |       |                       |  |
| 1,340,012            | •               | •   | •                | •          |               |          |                     | •        | •         | •       |       | 37                            | •                  |                      |       |                       |  |
| 995,170              | •               | •   | •                |            |               |          |                     |          |           |         |       |                               | •                  |                      |       |                       |  |
| 461,893              | •               | •   | •                |            |               |          |                     |          |           |         |       |                               | •                  |                      |       |                       |  |
| 1,618,584            | •               | •   | •                |            |               |          |                     |          |           |         |       |                               | •                  |                      |       |                       |  |
| 1,172,391            | •               | •   | •                | •          |               |          |                     |          | •         |         |       | 43                            | •                  |                      |       |                       |  |
| 376,757              | •               | •   | •                |            |               |          |                     |          | •         | •       |       | 39                            | •                  |                      |       |                       |  |
| 244,737              | •               | •   | •                |            |               |          |                     |          |           |         |       |                               | •                  |                      |       |                       |  |
| 1,782,286            | •               | •   | •                |            |               |          |                     |          | •         |         |       | 38                            | •                  |                      |       |                       |  |
| 20,025,563           | •               | •   | •                | •          |               |          |                     | •        | •         |         |       | 32                            | •                  |                      |       |                       |  |
| 3,493,552            | •               | •   | •                | •          | •             |          |                     |          |           | •       | •     | 37                            | •                  |                      |       |                       |  |
|                      | •               | •   | •                | •          |               |          | •                   | •        | •         | •       | •     |                               | •                  |                      |       | 1,4                   |  |
| 68,181,810           |                 |     |                  |            |               |          |                     |          |           |         |       |                               |                    |                      |       | 1                     |  |
| 1,223,755            | •               | •   | •                |            | •             |          |                     |          |           | •       |       | 49                            | •                  |                      |       |                       |  |
| 2,708,000            | •               | •   | •                | •          |               |          |                     |          | •         | •       |       | 37                            | •                  |                      |       | 1                     |  |
| 3,931,755            |                 |     |                  |            |               |          |                     |          |           |         |       |                               |                    |                      |       | 1                     |  |
| 9,390,002            | •               | •   | •                | •          | •             |          |                     |          |           |         |       | 44                            |                    | •                    |       | 1                     |  |
| 8,434,330            | •               | •   | •                | •          |               |          | •                   |          |           |         |       | 42                            | •                  |                      |       | 1                     |  |

## TABLE OF EFL ASSISTED BUILDING SYSTEMS PROGRAMS

The table on these pages presents one measure of the results of EFL's ten years of involvement in building systems development and application—the school plants constructed by eight of the building systems programs financially assisted by EFL. Several hundred other schools have been constructed using products and techniques spun off from these programs.

**Project Dollar Volume.** Two figures are given for the dollar volume of construction in each program. The first of these represents the contract building cost at the time of contract award. These figures were supplied by each building system program.

In order to provide some sense of the comparative value of programs bid and constructed at different times, a second figure, the dollar value in November 1971 construction dollars is also given. To derive these values, the contract building costs were brought up to equivalent November 1971 values in each area by use of the *Engineering News-Record* 22 Cities Building Cost Indexes.

**Type of Construction Management.** The column headed "MANAGER" on the table identifies the type of manager of the construction process employed on the program. The three types listed are:

- (1) a *general contractor* who has a single contract with the owner with responsibility for all construction services and to whom subsystems contracts may be assigned for supervision and coordination;
- (2) a *construction manager*, either an employee or contractor to the owner, who provides coordination and supervision of the construction work which is performed by other parties, each of whom has a contract with the owner for specific services;
- (3) a *management contractor* who has a contract with the owner to perform certain aspects of the work himself and to supervise and coordinate the work of other parties who may have contracts with either the owner or the management contractor to perform the majority of the work.

### Notes:

1. Figures include projects not yet completed.
2. SCSD also constructed a 3,600 sq. ft. Mockup Building.
3. SEF also constructed a 12,000 sq. ft. Pilot School.
4. Letters of intent issued for subsystem contracts.

exception of the systems planning consultant, Environment Systems International of Toronto, Ontario, consultants were from the Detroit area.

**CSP-1 Procedures.** Because of what was felt to be the relatively small size of CSP-1 and of the need for rapid completion of the additions, the CSP staff and advisory committee decided to derive their bidding and construction management procedures directly from those used on other large scale building systems programs.

The performance specifications used in the Toronto Study of Educational Facilities (SEF) program were modified by the consultants to meet Detroit codes and requirements. An important element of the SEF specifications is the "open system" method of insuring product compatibility by mutual naming of bidders in compatible subsystems.

A multi-stage bidding procedure similar to that used on the Florida Schoolhouse Systems Project (SSP) was combined with these performance specifications. In this procedure, bids for installed subsystems are taken following approval of preliminary design. Upon completion of working drawings by the architects, bids on the non-system portions of the work are taken.

**Multi-stage Bidding.** During the spring of 1970, the consultants worked with CSP and the architects to apply building systems to the four projects and to modify the SEF specifications to Detroit conditions. By June, five of SEF's subsystems had been selected for inclusion in the CSP Building System—Structure, Atmosphere (HVC), Lighting/ceiling, Interior Space Division (partitions), and Vertical Skin.

The architects' preliminary designs and budget estimates were approved in September 1970. Following a two-month bidding period, bids for the five subsystem contracts were taken on January 14, 1971. Although CSP believed there would be more interested parties, fifteen qualified bidders submitted thirteen compatible building systems. Subsystem contracts were awarded in March 1971.

Three of the five subsystem contracts were awarded to local installation contractors who bid national building systems products with the assistance of the national manufacturers. Of the remaining two, the structural subsystem contract was awarded to a national firm and the exterior skin subsystem contract to a Michigan firm with a regional market.

Out of four bids received on the exterior skin subsystem, three were rejected for technical reasons. The remaining proposal was accepted for scheduling reasons and because it was twenty-five per cent below the subsystem target cost. The erection speed of this subsystem

has proven to be an important advantage in enclosing the buildings before the onset of winter.

In order to expedite construction while allowing the architects sufficient time to complete the documentation of non-system elements, CSP decided to proceed with on-site construction before taking bids on the bulk of the non-system work. Accordingly, the sub-structure (foundations, etc.) for all four schools was bid as a separate contract in April 1971, and on-site work began in May. The six remaining non-system contracts were awarded in August 1971.

**CSP-1 Schedule and Results.** The building cost for the four additions averages \$30.84 per square foot. The building system comprises about 44 per cent of building cost and is about 10 per cent below its budget. The construction program includes an additional \$1.68 million for alterations to the existing plants at the four schools.

The current project schedule calls for completion of the schools in July 1972, a construction time of fourteen months from ground breaking and twelve months from the starting of structural steel erection. In spite of delays caused by a three-and-one-half week strike of Board of Education building trades workers, the schools were enclosed by mid-December 1971.

In addition to cost and time savings, CSP feels that the quality and adaptability of the systems schools is an asset for the school district. The four additions when completed will be the most fully air-conditioned plants in the Detroit Public Schools. The relocatable elements of the building system make it possible to change partition and environmental control layout to respond to program changes—a particular advantage in these additions which house vocational, technical, and science subjects.

### **CSP-1 Construction Management**

On CSP's first construction program, the responsibility for management of the construction process and for coordination of the four projects is shared by a team consisting of the owner, a scheduling consultant, and a construction manager. Construction work is performed by the twelve contractors—five system and seven non-system—each of whom has a contract with the school district.

In CSP terminology, the construction manager is known as the "management contractor," that is, the contractor for management services. Because this term is used by BSIC to describe another form of construction management (see definitions on page 13), the term "construction manager" will be used to identify Detroit's management contractor in this article.

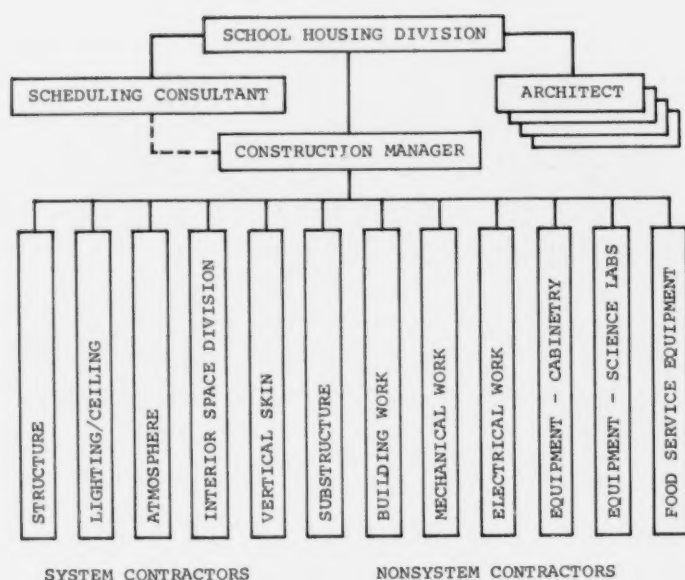


Figure 2

### CSP-1 Construction Management Organization

Although their roles are continually developing, each member of the management team has certain basic responsibilities in the CSP-1 construction process. In the following paragraphs, some of these responsibilities will be examined.

*The Construction Manager.* The role of the CSP-1 construction manager is patterned on a similar procedure used on the Toronto SEF program. The construction manager is under contract to the school district only to supervise and coordinate the twelve construction contractors on the four school sites.

Shortly after work on the substructure contract had begun, Construction Management, Inc., a newly-formed subsidiary of a Detroit general contracting firm, was selected from a number of contenders on the basis of a "negotiated lump sum professional fee."

Construction Management, Inc. provides a full-time superintendent on each site who coordinates and supervises on-site construction activities. These superintendents are under a project manager responsible within the firm for coordinating the four projects as they progress in a rapid, overlapping construction sequence.

*The Scheduling Consultant.* Although many construction management firms provide their own scheduling services, CSP felt that, because the CSP-1 construction manager had been hired after construction had begun, the CSP scheduling consultant, Edward Colbert, should be retained during the on-site construction process.

Most recent Detroit school construction projects have employed scheduling consultants to assist the architect and the general contractor in developing project schedules. On CSP-1, this consultant serves as an expeditor and an overall "watchdog," monitoring the performance

not only of the contractors, but of the architects and the owner as well.

The scheduling consultant generates and revises the computerized CPM schedule which is used to coordinate fabrication and erection activities. This schedule is also used to determine the amount of holdback on contractor payments. If a contractor finishes his work on time, he may apply to have the traditional ten per cent retainage reduced to three per cent. If he is late according to the basic schedule, he may be liable for \$300 per day damages.

*The Owner.* The third member of the management team is the owner. Traditionally, the Detroit Public Schools have taken an active role in project field supervision through the School Housing Division staff. On CSP, this supervision is centralized in the CSP Construction Coordinator, Mr. Edward W. Gabert, AIA.

The district's activities have intensified because, on CSP-1, the owner's responsibilities have increased to include a number of on-site services—provision of fences, guards, temporary heat, fire insurance, site toilets—traditionally provided by the general contractor.

In addition, Mr. Gabert's duties include the handling of bulletins, field orders, change orders, progress payments, and the other administrative work necessary to keep \$11.5 million worth of work flowing smoothly through the owner's jurisdiction.

*Unanticipated Benefits.* The breaking down of the construction process into twelve contracts under a construction manager has allowed more firms to have a piece of the action. For example, a general contracting firm which did not have the resources to coordinate four simultaneous projects totalling \$11.5 million was capable of successfully bidding and fulfilling the building work contract of \$3.75 million.

In order to acquaint area young people with the program and with the possibilities of a career in construction, Mr. Fred Myers, the site superintendent on the Cooley High School project, initiated a program of project tours for students from the school area. This program has now been adopted on all four CSP-1 sites.

### The Impact of CSP

To date, CSP appears to have demonstrated that systems building techniques are a viable solution to the problem of providing school facilities in Detroit. The use of the CSP approach has already resulted in cost savings over conventional techniques and is well on its way to a major reduction in construction time. The facilities provided are of high quality and possess adaptability to respond to change.

The CSP staff and advisory committee view CSP activities as the beginning of changes in the design and construction process which will result in the development and use of more effective methods. CSP itself is looking forward to a larger CSP-2 in which the lessons of its first program can be applied. According to Mr. Cleland:

In the next program (CSP-2) we're going to continue multi-project construction to get bulk economies. Although we may modify specific subsystems and organization of bidding, we will continue to seek the advantages of industrialized processes (3).

#### FOOTNOTES

- (1) Cleland, Wallace B., "Detroit's CSP and the First Four Schools," *Michigan Society of Architects Monthly Bulletin*, May 1971.
- (2) Letter from Wallace B. Cleland to Joshua A. Burns, December 23, 1971.
- (3) Cleland, Wallace B., quoted in "Systems Construction in Detroit, A School Board Decision," *Air Conditioning, Heating & Refrigeration News*, October 18, 1971.

TABLE I

#### CSP ADVISORY COMMITTEE

ALVIN G. SKELLY, Committee Chairman  
Deputy Superintendent, School Housing Division,  
Detroit Public Schools

PHILIP BAILEY  
Vocational Education Consultant,  
Michigan Department of Education

VIRGINIA BROWN  
Co-Chairman, Building & Sites Committee,  
Detroit Board of Education

H. FRED CAMPBELL  
Chairman of the Board  
H. F. Campbell Companies

WILLIAM C. DENNIS  
Secretary-Manager  
The Builders Exchange of Detroit and Michigan

LLOYD E. FALES  
Supervisor, School Plant Planning,  
Michigan Department of Education

RICHARD L. FEATHERSTONE  
Department Chairman, College of Education,  
Michigan State University

HOWARD G. HAKKEN  
Architect, Property Development Group, Inc.

JAMES A. HATHAWAY  
Member, Detroit Board of Education

NATHAN JOHNSON  
Architect, Nathan Johnson & Associates, Inc.

WILLIAM L. KAHN  
Professional Engineering (Mechanical),  
Kahn Associates, Inc.

C. THEODORE LARSON  
Professor of Architecture, University of Michigan

ROGER W. MARGERUM  
Architect, Smith, Hinchman & Grylls  
Associates, Inc.

CHARLES E. MORTON  
Member, Board of Education, State of Michigan

LEWIS M. RAMBO  
Staff Representative, Education and Training  
Dept., Ford Motor Company

LEO G. SHEA  
Architect, Louis G. Redstone Associates, Inc.

HORACE L. SHEFFIELD  
Administrative Assistant,  
United Automobile Workers of America

LINN SMITH  
Architect, Linn Smith, Demiene, Adams, Inc.

NORMAN O. STOCKMEYER  
Chairman, Wayne State University Board of Governors  
Member, Board of Education  
Wayne County Intermediate School District

LINDA TADAJEWSKI  
Co-Chairman, Building & Sites Committee,  
Detroit Board of Education

CHARLES WELLS, JR.  
School Planning Consultant,  
Wayne County Intermediate School District

WARREN W. YEE  
Professional Engineer (Structural),  
Pierce, Wolfe, Yee & Associates

#### EX OFFICIO

BERNARD L. COKER  
Assistant Superintendent, School Housing Division,  
Detroit Public Schools

BEN E. GRAVES  
Project Director, Educational Facilities  
Laboratories, Inc., Chicago

ALAN C. GREEN  
Secretary-Treasurer, Educational Facilities  
Laboratories, Inc., New York

JOHN LANSING  
Director, Building Program Coordination  
School Housing Division, Detroit Public Schools

## CONSTRUCTION SYSTEMS PROGRAM (CSP-1)

Board of Education of the City of Detroit  
Detroit, Michigan

### *Project consultants:*

Environment Systems International, Inc., systems planning  
Migdal, Layne, and Sachs, mechanical and electrical engineering  
Sidney E. Shorter, structural engineering and building codes  
Edward Colbert, construction cost and scheduling  
James H. Neubacher, educational planning

### *Construction contractors:*

#### *Subsystems:*

STRUCTURE: Keene Building Products Corp. (Romac MODULOC)  
ATMOSPHERE: W. J. Rewoldt Co. (ITT Nesbitt RTMZ)  
LIGHTING/CEILING: Service Art Plastering, Inc. (Armstrong C-60/30)  
INTERIOR SPACE DIVISION: R. E. Leggett Co. (Flangeklamp)  
VERTICAL SKIN: Precast/Schokbeton, Inc. (DUOTEK-C)

#### *Nonsystem:*

SUBSTRUCTURE: Matthew Lalewicz, Inc.  
BUILDING WORK: A. J. Anderson Construction Co.  
MECHANICAL WORK: Brady Plumbing and Heating Co., Inc.  
ELECTRICAL WORK: Litt Electric Co., Inc.  
SUPPLEMENTARY EQUIPMENT 1: Peninsular Slate Co.  
SUPPLEMENTARY EQUIPMENT 2: B. F. Farnell Co.  
FOOD SERVICE EQUIPMENT: Great Lakes Hotel Supply Co.

*Construction manager:* Construction Management, Inc.



Mr. Wallace B. Cleland, CSP Technical Director; Mr. Murle Denney, superintendent for Construction Management, Inc., Sherrard School.



## SHERRARD SCHOOL ADDITION

*Architect:* Nathan Johnson and Associates, Inc.

*Building size:* 44,000 square feet

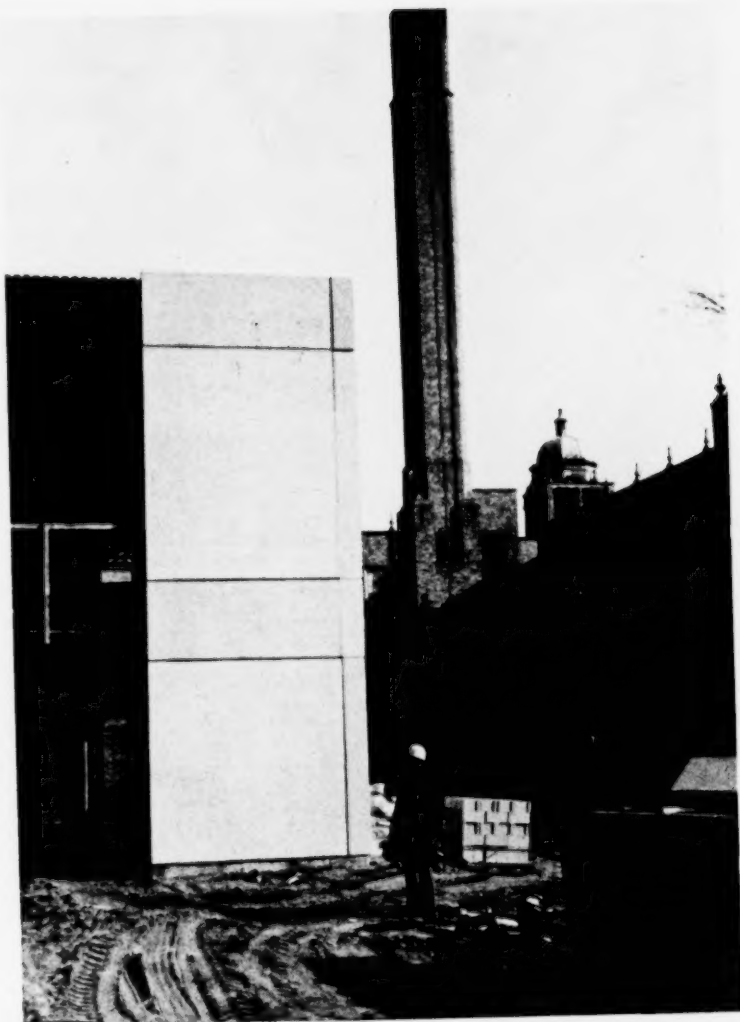
### *Project costs:*

SUBSYSTEMS LISTED: \$701,956, or \$15.95/sq. ft.  
BUILDING COST: \$1,405,407, or \$31.94/sq. ft.  
CONSTRUCTION COST: \$3,100,000 including site and renovation work

### *Project schedule:*

CONSTRUCTION BEGUN: May 1971

CONSTRUCTION COMPLETED: estimate July 1972



Mr. Romeo P. Corriveau, A. J. Anderson Construction Co.;  
Mr. Fred Myers, superintendent for Construction Management, Inc., Cooley High School.

## ROBERTS ADDITION TO COOLEY HIGH SCHOOL

*Architect:* Kissinger-Holzhauer, Inc.  
*Building size:* 105,000 square feet  
*Project costs:*

SUBSYSTEMS LISTED: \$1,392,762, or \$13.26/sq. ft.  
BUILDING COST: \$3,287,092, or \$31.30/sq. ft.  
CONSTRUCTION COST: \$6,200,000 including site and  
renovation work

### *Project schedule:*

CONSTRUCTION BEGUN: May 1971  
CONSTRUCTION COMPLETED: estimate July 1972



## CERVENY SCHOOL ADDITION

**Architect:** King and Lewis Architects, Inc.

**Building size:** 74,600 square feet

**Project costs:**

SUBSYSTEMS LISTED: \$936,276, or \$12.55/sq. ft.

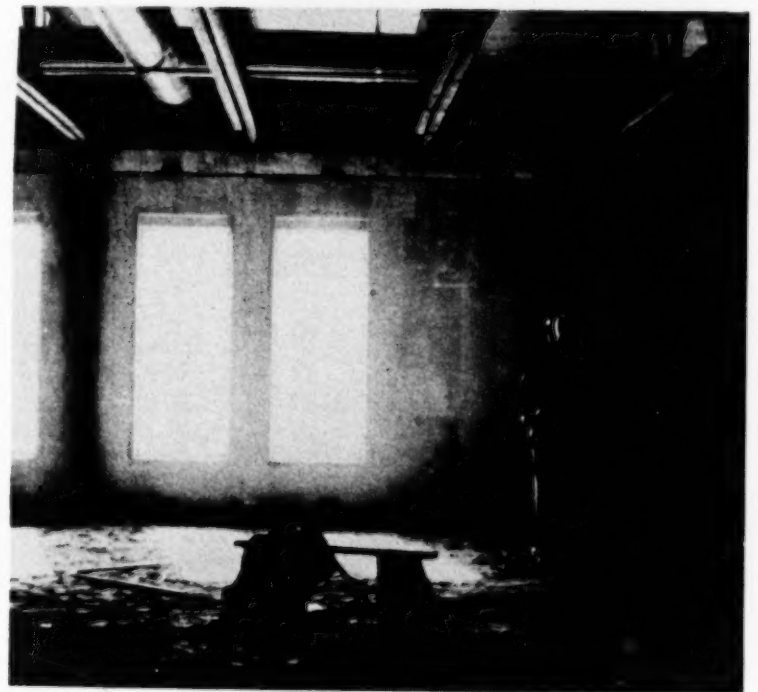
BUILDING COST: \$2,121,968, or \$28.45/sq. ft.

CONSTRUCTION COST: \$3,604,000 including site and renovation work

**Project schedule:**

CONSTRUCTION BEGUN: May 1971

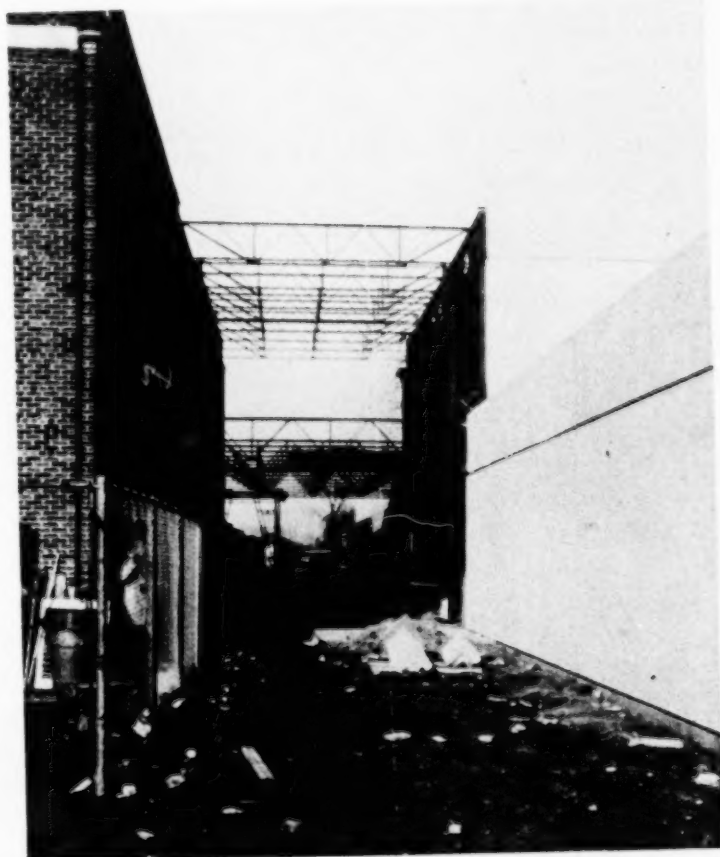
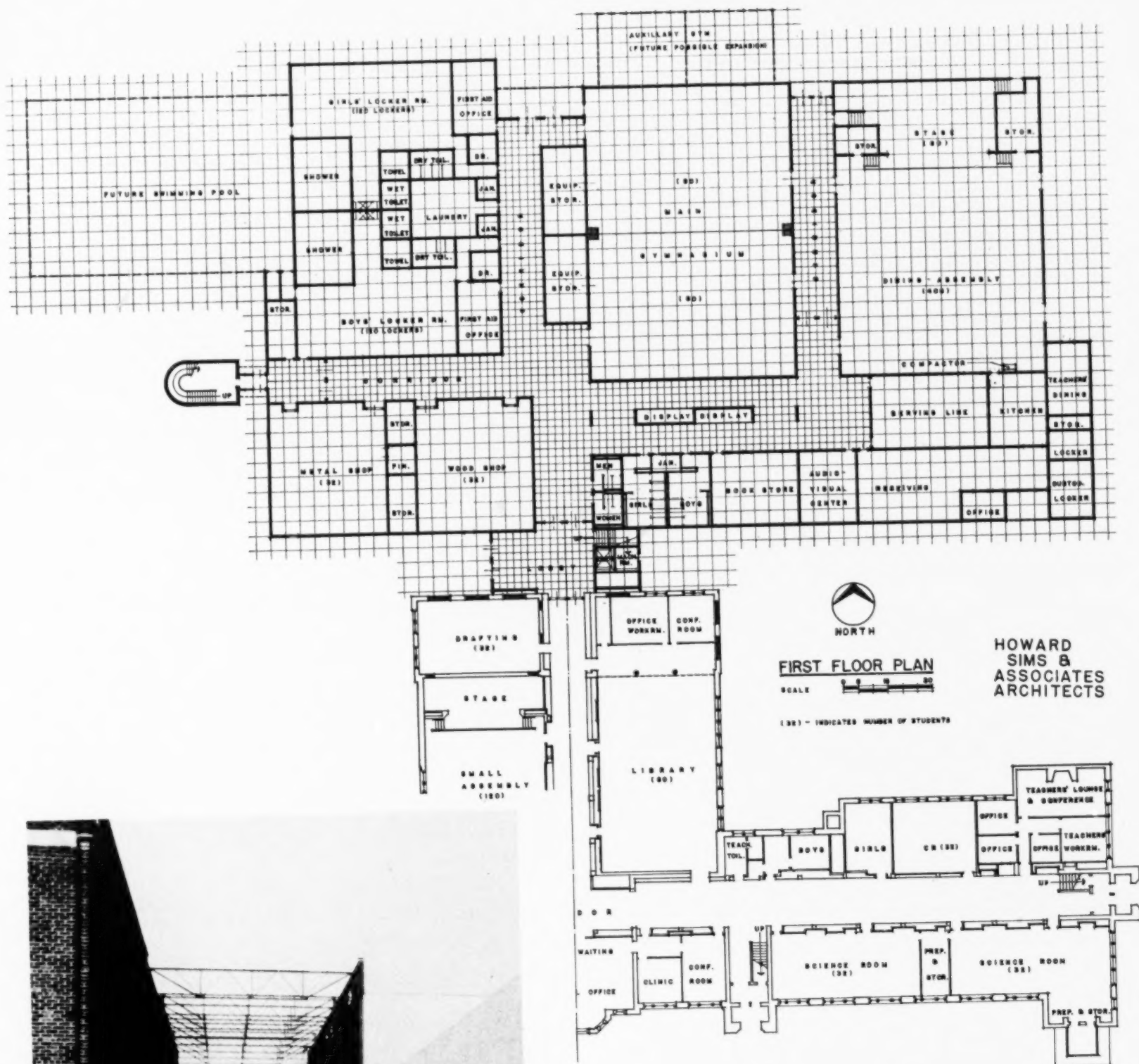
CONSTRUCTION COMPLETED: estimate July 1972



**FIRST FLOOR PLAN**  
SCALE 1/8" = 1'-0"

CERVENY SCHOOL  
K&L ARCHITECTS INC.





## BOYNTON SCHOOL ADDITION

**Architect:** Howard Sims and Associates

**Building size:** 54,625 square feet

**Project costs:**

SUBSYSTEMS LISTED: \$714,811, or \$13.08/sq. ft.

BUILDING COST: \$1,765,677, or \$32.32/sq. ft.

CONSTRUCTION COST: \$3,300,000 including site and renovation work

**Project schedule:**

CONSTRUCTION BEGUN: May 1971

CONSTRUCTION COMPLETED: estimate July 1972

# RAS

## MONTREAL'S RECHERCHES EN AMENAGEMENTS SCOLAIRES

On December 16, 1971, the Montreal Catholic School Commission (MCSC) authorized, by letter of intent to the five subsystem contract nominees, the undertaking of a program of construction applying the RAS (Recherches en Amenagements Scolaires) building system. Including a Pilot School already under construction, the program consists of thirteen elementary and secondary schools and additions totalling 1,704,200 square feet of new construction to be completed by the end of 1974.

The five firms, nominated as successful subsystems bidders in March 1969, receiving letters of intent are:

STRUCTURE: Francon, Ltee.

HVC: Lennox Industries of Canada

LIGHTING/CEILING: Electrolier Corporation

PARTITIONS: B. K. Johl, Inc.

ELECTRIC/ELECTRONIC SERVICE: Bedard-Girard, Ltd.

The prime consultant to MCSC for the development of the RAS program, IRNES, estimates that the contract value for these five subsystems of \$12,270,240 represents about 35 per cent of the program's total building cost of approximately \$35 million.

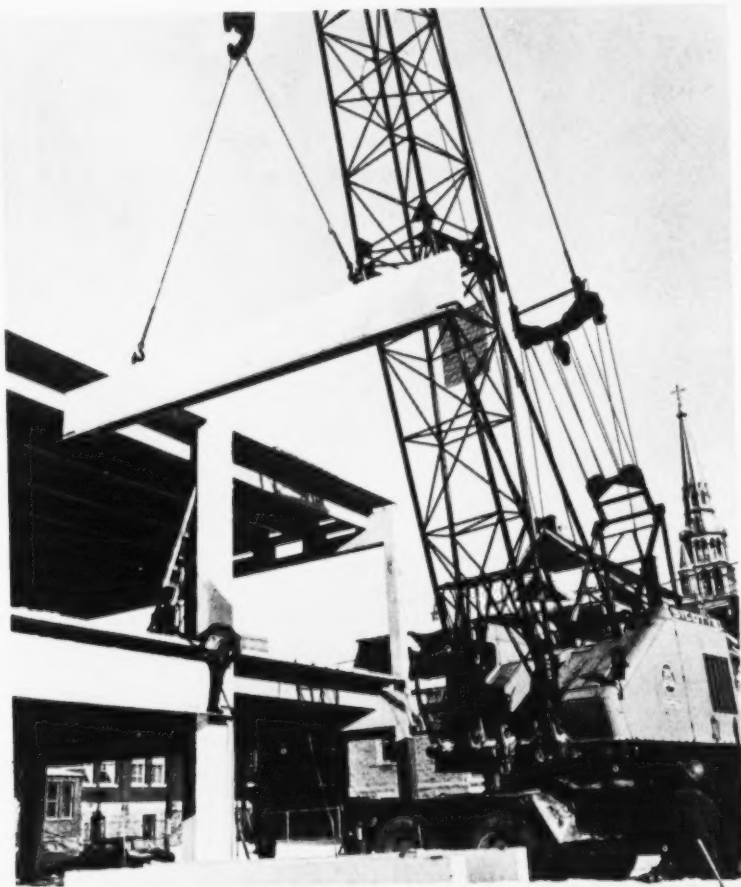
Construction of the 58,815 square foot RAS Pilot School, St. Joseph Elementary, began in October 1971. The building cost is \$21.30 per square foot. Completion of the school is scheduled for mid-March 1972.

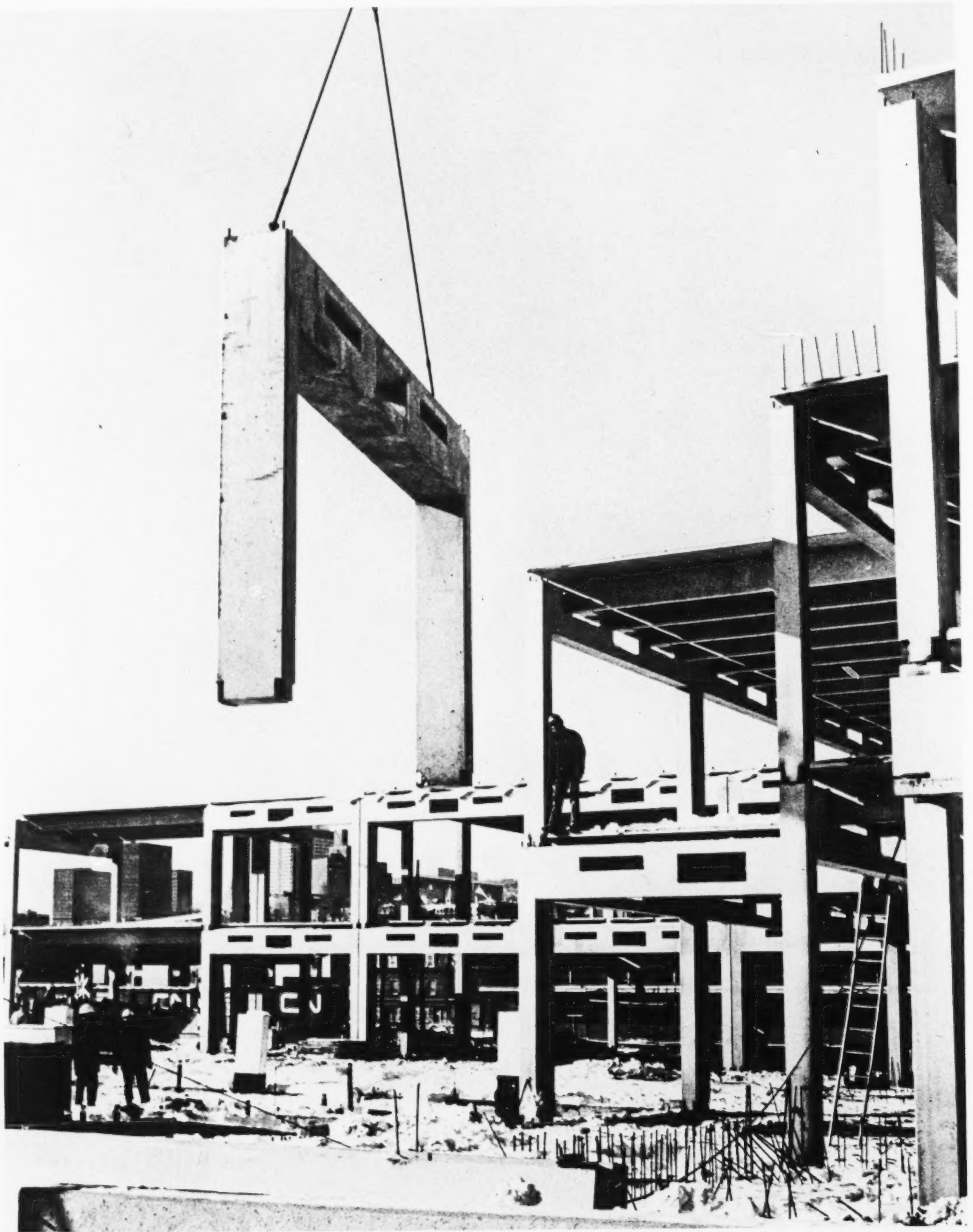
Erection of the structural subsystem on the Pilot School began in mid-November and is illustrated on these pages. The structural subsystem consists of precast concrete portal frames, double-tee spanning members, and peripheral beams (spandrels) and columns. Special precast floor elements are used in mechanical room bays to support the Lennox HVC units.

To erect the structure, the rigid portal frames which span 20 feet and weigh about 5½ tons are placed on prepared foundations. Double-tee sections ten feet in width and spanning from 20 to 80 feet are supported on two of these portals. Adjacent bays are framed in the same manner and the vertical structure of upper floors is created by stacking portals.

In order to expedite the construction process, the structural installer places the Lennox air-handling units on the mechanical bay slabs on the ground. The slabs and HVC units are then placed in the building together.

Of special interest to city school districts, the RAS building system has been developed in response to urban requirements which, among other criteria, call for high fire resistance ratings of the building fabric plus automatic fire protection. As one result, fire sprinklers, although not a part of the building system, have been integrated with the lighting/ceiling components.





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#### PHOTO AND DRAWING CREDITS

Earl R. Flansburgh and Associates, pp. 7 (bottom), 8 (bottom)

Hutchins Photography, Inc., pp. 6, 9 (bottom)

King and Lewis, p. 19

Robert Prevost, pp. 22-23

Carol Rankin, p. 8 (top)

Howard Sims and Associates, p. 20

George Zimberg, p. 7 (top)

BSIC/EFL, all others

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